EFFECTIVENESS OF NONPOINT SOURCE NUTRIENT CONTROL PROGRAMS

Control of nonpoint source pollution on a complete watershed basis has been completed on only one watershed in the Illinois River Basin. This was Oklahoma's first 319(h) demonstration project and was completed over a three year period. Initial analysis of water quality data indicate that this project was successful in reducing nutrient loading to surface waters. Given the relatively consistent patterns of land use with the Illinois River Basin as whole, transfer of the information gathered from this project should be easily accomplished; however, success will be closely tied to the availability of cost-share funds for land use improvements.

The total cost of BMP implementation on this watershed was approximately $100,000. This includes technical assistance, landowner contact, and BMP implementation. The cost for BMP implementation was $50,000. The Battle Branch watershed covers 5970 acres; therefore, it can be calculated that the cost of remediation was $16.75 per acre. If it is assumed that land uses in the Battle Branch watershed represent typical or average conditions across the Illinois River Basin, the basin wide cost for remediation is:

$16.75 x 576,000 acres = $9,648,000

It should be obvious that this figure only loosely estimates the funds that will be required for BMP implementation in the Illinois River Basin considering the assumptions on which it was based. Despite the shortcomings of this estimate it should be useful in discussions of the relative costs of nutrient control programs in point versus nonpoint source programs. It should also be noted that some of this cost has already been spent in the monitoring and implementation activities that have already occurred in the watershed. It is possible that less than the $10 million estimate will be necessary to implement practices since we already have water quality data. However, a survey of all the county District Conservationists requesting estimated needs for BMP implementation (and this figure includes only funding for implementation and technical assistance) estimated approximately $7 million necessary for implementation across the basin. When costs for monitoring to assess the effectiveness (in some cases, both "before and "after" monitoring may be necessary, rather than just "after") and education are added, the $10 million dollars may be accurate.

A. Battle Branch Demonstration Project

Oklahoma's first Section 319h project was completed during FY 93. The Battle Branch watershed was identified as one of Oklahoma's highest priority watersheds in the 1991 watershed prioritization efforts. This project can be viewed as a successful endeavor by several different measures. Although the original meaning of the term 'demonstration project' may have been BMP-oriented, that is, the projects were intended to demonstrate

the efficacy of BMPs in reducing NPS pollution, this project has 'demonstrated' other important factors as well. It was demonstrated in this project that the implementation of BMPs reduced levels of nutrients in Battle Branch; however, equally important to the ability of BMPs to reduced pollution is the level of voluntary public participation. This project 'demonstrated' that public interest was high as 84% of landowners participated in the project. The importance of project administration cannot be overlooked as this project involved the coordination of efforts between local, state, and federal agencies, landowners, and contractors. The fact that this project was a success 'demonstrates' that the administrative mechanism through EPA and OCC is adequate to ensure that 319h projects are properly administered and carried out. It was also 'demonstrated' that project successes could be transferred to other areas as witnessed by the inclusion of the entire Flint Creek watershed as a SCS Hydrologic Unit Area and the start of an implementation project in the Peacheater Creek watershed.

Table 36 lists of the final totals for BMP implementation:

Table 36. BMPs Installed in Battle Branch Watershed.

Number of "Conservation Plan of Operation"	16
Total Acres under "Conservation Plan of Operation"	1424
Waste Management Plans	9
Rural Wastewater Systems (Septic Tanks)	10
Dairy Lagoons	3
Waste Utilization Management Operations (acres)	774
Pasture and Hayland Operations (acres)	592
Poultry Composters	6
Forest Land Management (acres)	32
Tree Planting (acres)	172
Waste Storage Structures	4
Soil Testing	129

Data Analysis:

Battle Branch was monitored regularly between early 1986 and mid-1987, and was monitored monthly between January of 1990 and August of 1994. The monitoring during these periods has consisted of the collection of both runoff event and base flow samples. Runoff event samples have been collected by means of an automated sampler which is

triggered by a float switch in the stream, while base flow samples consist of monthly grab samples. Thirty-five base flow samples and fourteen runoff event samples had been collected through July, 1992.

The intent of sampling was to characterize pre-implementation conditions and to monitor water quality improvements as they occurred. BMP implementation is described in **Table 36**; however, it is difficult to accurately draw a line where implementation was complete and to base water quality assessments on changes which occur after this point in time. There are several reasons which can explain the difficulty in identifying a point in time which to separate pre- from post- implementation: 1) actual implementation was spread out over more than one year between early 1991 and mid-1992, 2) some BMPs have a much more direct and rapid effect on water quality than others; therefore, the precise times that these were installed would be known and it is unlikely that installation of these practices was within a short time span, 3) many land use improvements were made through landowner contacts (prior to the actual date of 'official' BMP implementation) and do not constitute identifiable or quantifiable management practices as they are not necessarily included in the Conservation Plan of Operation and, 4) flushing of contaminated shallow ground water may take a considerable period; therefore, benefits may not be noticeable until some time in the future.

After consideration of all of these factors a cut-off date between pre- and post-implementation of August 1, 1991 was chosen. The represents more or less the mid-point between the beginning of landowner contacts and the completion of BMP implementation. A summary of the data can be seen in **Table 37**.

Table 37. Baseflow versus Runoff Event in Battle Branch (mean values in mg/L).

Pre-Implementation							
Nitrate		Kjeldahl		T. Phosphorus		o-phosphate	
BF	RE	BF	RE	BF	RE	BF	RE
1.98	2.33	1.62	0.73	0.053	0.062	0.067	0.406
Post-Implementation							
Nitrate		Kjeldahl		T. Phosphorus		o-phosphate	
BF	RE	BF	RE	BF	RE	BF	RE
2.20	4.40	0.22	0.20	0.031	0.040	0.024	0.035

(BF = Baseflow; RE = Runoff Event)

NITRATE

Nitrate values do not show any appreciable trends over the course of sampling and there is considerable variation among results over relatively short periods. As seen in **Table 37**, there was a slight decrease in base flow samples (1.62 to 0.22 mg/L, respectively); however, this would not appear to be significant due to the relatively high standard deviation of results for both periods (1.21 and 0.91, respectively).

There was also little difference between pre-implementation base flow and runoff event nitrate values. This indicates that entry of organic matter into the stream from overland runoff was not an important issue. It also indicates that the majority of nitrogen is in the form of benthic algae and represents drifting cells and not allocthonous materials, such as animal litter.

Mean runoff event values increased from 2.33 to 4.40 between pre- and post-implementation. This would appear to be a significant increase; however, the post-implementation value is based on only two data points so some caution should be taken in making inferences concerning this increase. A casual look at the runoff event data indicates a trend towards increasing nitrate values in runoff samples and this phenomenon will be closely observed as additional samples are taken.

Total Kjeldahl Nitrogen (TKN)

There was considerable variation among TKN values under both runoff and baseflow conditions; however, post-implementation baseflow values have been low and fairly uniform (mean = 0.22 mg/L; SD = 0.11). This compares with pre-implementation values of mean = 1.62 mg/L; SD = 1.77. There would appear to be adequate data to suggest that baseflow TKN levels have been reduced.

TKN values during runoff events were lower than during baseflow conditions during both pre- and post- implementation. This indicates two conditions: 1) TKN is not entering the stream in runoff (TKN levels in the stream are actually being diluted by runoff water) and, 2) the major source of stream TKN is drifting benthic organic material. Post-implementation runoff values are lower than pre-implementation values; however, this is based on a very small number of data points and any actual differences are probably more attributable to reductions in groundwater than surface contributions.

Pre-implementation TKN values ranged as high as 8.77 mg/L while the maximum post-implementation value was 0.50 mg/L. With a baseflow mean value of 0.22 mg/L it may not be realistic to expect further reductions. If this value could be achieved in all creeks of the Illinois River Basin, it would represent a significant reduction in nitrogen loading to the Illinois River.

Phosphorus

Phosphorus analysis has been somewhat inconsistent during the period of the project. For the first period of the study, only ortho-phosphate was measured and during the second part of pre-implementation only total phosphorus was measured. These differences are due to different laboratory protocols and project emphasis. While this may present some problems in data analysis it does not preclude making some conclusions concerning changes in water quality.

Approximately 80% of the phosphorus present was in the ortho-phosphate form which indicates a readily available supply of phosphorus for algal growth. Ortho-phosphate decreased from a mean of 0.067 during pre-implementation baseflow conditions to 0.024 mg/L during post-implementation. Although there is no uniformly accepted level of ortho-phosphate which is considered to be deleterious, it is generally accepted that values greater than 0.050 mg/L can cause stream problems and values in excess of 0.020 mg/L can result in downstream loading problems. From this data it is apparent that a significant decrease has occurred; however, the stream and its receiving waters could benefit from further reductions.

Ortho-phosphate values during runoff events were very high during the early period of monitoring ranging from 0.030 to 0.96 mg/L with a mean of 0.41. These are very high values and represent environmentally significant runoff of nutrients from land surfaces. These values were reduced to 0.035 mg/L during post-implementation, and despite the small number of samples upon which this mean is based, it is apparent that a significant reduction in runoff contributions has occurred.

Mean total phosphorus values also decreased somewhat between pre- (0.053 mg/L) and post-implementation (0.031 mg/L) during baseflow conditions. This phenomenon also occurred during runoff event samples.

Although total phosphorus values are not available from the early monitoring period, conclusions can be drawn about them. With the extremely high ortho-phosphate values that were found, the total phosphorus values would of necessity been correspondingly higher. With this in mind, it is obvious that very significant reductions in phosphorus loading has occurred in this stream.

FUTURE PROGRAMS

These future programs, already planned, make up the final segment of the Illinois River Comprehensive Basin Management Plan. Following the implementation of these plans, and assessing the success of the practices implemented, it may be necessary to add a supplementary plan to address either newly realized concerns or problems that were not

adequately dealt with by these planned programs.

a. Total Maximum Daily Load (TMDL)

Given the variety and number of point and nonpoint sources and the economic impacts of remediation, it is essential that clean-up efforts be directed towards the most cost-effective and beneficial endeavors. The first step towards completing this process is the development and implementation of a TMDL.

The TMDL will determine the level at which nutrients can be discharged to the river without causing water quality violations. The entire process of watershed restoration will be predicated on the accurate determination of the carrying capacity of the watershed. In this regard, the effects of nutrient loading on Lake Tenkiller must also be considered. It is likely that the levels of loading which would protect Lake Tenkiller will be less than those which would protect the Illinois River.

After determination of the TMDL, the difficult task of allocating permissible waste loads to various discharges must be undertaken. This will be a difficult process as it will involve some expense to all parties involved. Given the high levels of nutrients which currently exist in the river, it is likely that the TMDL process will determine that a significant decrease will be required before water quality standards can be met. Research has suggested that the majority of the loading is due to nonpoint source pollution, although point sources still contribute significantly to the problem. Most of the point sources in Oklahoma have already undergone significant upgrades. Thus efforts should focus primarily on reducing nonpoint sources although consideration should still be given to upgrading point source treatment. Consideration must also be given to the proportion of loading from the various subwatersheds and the two states. Oklahoma and Arkansas should coordinate implementation of pollution reduction measures to maximize the benefits of individual state efforts. In conclusion, the pros and cons of reducing point versus nonpoint sources must be considered in light of feasibility, cost-effectiveness, maintainability, and long-term effectiveness.

b. TMDL Development

There are two inter-related issues which must be considered and addressed in the development of a TMDL for the Illinois River Basin: 1) the size of the Illinois River watershed complicates the development of a TMDL and, 2) cross border issues aggravate the issue as the two states have water quality goals and priorities which are not necessarily congruent.

The most appropriate solution to the first issue is to divide the Illinois River Basin into smaller sub-basins. This would not only serve to reduce the size of the area under consideration but would also solve some of the problems associated with the second

issue. In Oklahoma it would appear that separate TMDLs should be developed for the Baron Fork, Flint Creek, and the Illinois River. The problem with division into subbasins arises when it becomes necessary to explain to landowners why they are not eligible for cost-share assistance based on where they live in the basin. The rapport between conservation districts and local landowners is damaged when the district conservationist must turn down an application for cost-share assistance because the landowner lives in the Telemay and Dog Hollow watershed (priority 7- OCC priority list) but his brother in the Peacheater Creek watershed (priority 1- OCC priority list) receives assistance.

The Oklahoma Department of Environmental Quality is currently in the process of developing a TMDL for the Oklahoma portion of the river, incorporating the 40% phosphorus reduction recommended by the Lake Tenkiller Clean Lakes Study, to help the Illinois River meet its beneficial use criteria. Portions of the Illinois River and tributaries are currently listed on the Oklahoma 1998 303(d) list as being impaired by metals, nutrients, siltation, organic enrichment/dissolved oxygen depletion, and noxious aquatic plants. Sources of these problems are identified as nonpoint source, nonirrigated crop production, pasture land, rangeland, feedlots, animal holding/management facilities, highway construction, road construction, bridge construction, land development, on-site wastewater systems, dam construction, flow regulation/modification, and municipal sewage systems.

The second issue will involve considerable technical and political skill. USEPA Region VI attempted to address this issue through the establishment of a technical committee composed of state agency personnel from both states. The purpose of this committee is to establish water quality goals and a procedure for establishing the TMDL. This committee agreed to work towards a 40% reduction (based on the recommendations of the 1994 Clean Lakes Report) of the total phosphorus load to Lake Tenkiller. State and Federal Agencies in both states have agreed to work towards this goal.

Whatever approach is taken, it will be necessary to establish water quality goals in specific stream reaches. At a minimum, water quality goals must be established at the Oklahoma/Arkansas border and at the head of Lake Tenkiller. In Oklahoma it would be desirable for water quality goals to be established at the mouths of major river tributaries.

Due to the high levels of nutrients which are found at the border and at the head of Lake Tenkiller, it can be predicted that any TMDL will determine that significant reductions in nutrient loading must occur. The ultimate determination of the cost and feasibility of reduction, as well as the allocation of loads to various sources, will be a difficult process; however, this issue must be faced if an effective plan to manage river and downstream water quality is to be established.

C. Best Management Practice (BMP) Implementation Plan

Implementation of the TMDL in Oklahoma may require further point source controls as well as significant nonpoint source controls. One of the difficulties in reducing nonpoint source pollution is that most efforts at reduction must be made on a voluntary basis as few rules and regulations apply to nonpoint source pollution. However, Oklahoma has made an attempt to regulate nonpoint sources of pollution in sensitive watersheds. The 1998 poultry bill passed in the state of Oklahoma sets specific limits with regards to the application of poultry litter in sensitive watersheds such as the Illinois River. Soils and litter must be tested before litter can be applied and litter must be applied on a phosphorus basis by state certified litter applicators. In addition, poultry growers must attend water quality based training courses provided by the integrators in order to participate in the program. A program is also being developed to transport excess litter outside of the basin to areas where soil phosphorus supplementation is needed. These efforts will likely reduce the rate at which poultry litter is applied to the land and thus reduce the concentrations of nutrients in the stream.

In addition, the governor of Oklahoma set aside monies to be used on a cost-share basis to implement BMPs in the basin. These BMPs will likely focus on protection of riparian areas and streambank stabilization techniques. Federal Environmental Quality Incentives Program (EQIP) monies are also available in the watershed for implementation of BMPs. Federal monies have the advantage that they can be used in both Oklahoma and Arkansas, whereas state monies are state-specific. This advantage is critical in the Illinois basin where much of the headwaters are in Arkansas. More and more research indicates that BMPs must be implemented starting in the headwaters and then move downstream to be successful in improving water quality. The most cost-effective BMPs are those that reduce NPS pollution at its source. The political boundaries are still an issue, however, because Oklahoma and Arkansas draw their federal money from different pots as they are in different EPA Regions. Spending Oklahoma dollars in Arkansas is a hard sell, just as spending Arkansas dollars in Oklahoma would be a hard sell.

Fortunately, the poultry industry, in particular, has taken significant steps to curb the impact from their operations. All Tyson growers (thus, both in Oklahoma and Arkansas) must have their litter and soil tested prior to litter application. All Tyson growers must apply litter on an approved phosphorus-ratio basis, rather than on a nitrogen basis. All Tyson growers must attend mandatory water quality training courses. Failure to comply with these rules results in termination of the Tyson-Grower contract. Other poultry companies are likely to follow Tyson's lead and require these steps of their growers.

Oklahoma plans to implement BMPs which address the priority issues in priority areas. The Oklahoma Nonpoint Source Working Group, a group of federal, state, and nonprofit agencies with water quality concerns was asked to rank watersheds in the state of Oklahoma as priorities for future work. The Illinois River and Baron Fork watersheds were

ranked in the top five. The OCC plans to use this information to focus efforts in priority watersheds.

The OCC has allocated a significant portion of their FY1999 funds to address nonpoint source pollution problems in the Illinois River. Over 2 million dollars will be used to provide cost-share assistance to landowners to install BMPs in the watershed. The money will also be used to monitor water quality and other factors to verify the effects of these installations. The program will be administered by a Watershed Advisory Group (WAG), made up of local citizens and decision makers. The WAG will determine what types of BMPs will receive cost-share assistance and where the program should be concentrated.

The work will involve both implementation of BMPs and educational programs to reduce nonpoint source pollution in the Illinois River Basin. It is likely that many of the initial efforts in Oklahoma will focus in the Baron Fork watershed as it was identified as a priority, both by the Nonpoint Source Working Group, and by previous water quality studies. Water quality studies indicated that the Baron Fork was one of the most impacted streams in the system. Funds available at this time for implementation, although substantial, are likely not sufficient to implement necessary BMPs throughout the watershed. Thus initial §319 and state cost-share implementation funds will be targeted at areas where the need is greatest and the Baron Fork watershed contains the highest concentration of these in Oklahoma. Federal EQIP funds will be likely be targeted throughout the Illinois basin as will future §319 and state cost-share funds once implementation is complete in Baron Fork. Education efforts, however, will have a basin-wide focus. The OCC will continue to address water quality issues in the Illinois River Watershed through the implementation of BMPs as long as the Nonpoint Source Working Group identifies it as a priority watershed.

Corresponding to this effort, the Oklahoma Scenic Rivers Commission has focused on protection of the Illinois River. Beginning in 1993, the OSRC, the National Park Service, Oklahoma State University, and concerned local citizens began developing a plan to address the problems in the Illinois River corridor and set specific goals towards that end (OSRC 1998). The public felt that the river should be managed to emphasize naturalness and aesthetics. The group felt that attempts should be made to influence river users by education, such that their actions will protect and promote the health of the aquatic ecosystem. Should these efforts prove insufficient, rules and regulations should be designed to protect the environment. The effort organized three working teams to address specific issues related to the river. The teams identified the following goals (OSRC 1998):

Corridor Values

- Create constructive relationships with landowners by providing information and assistance regarding the full range of voluntary private land protection techniques.
- Minimize the impacts of development and construction within the Illinois River basin by encouraging local governments to adopt regulations to control development in

flood plain areas; monitor population and growth trends in the basin.

- Seek voluntary compliance with private landowners to establish and maintain a vegetated buffer of 60-100 feet along the river and its tributaries and to utilize existing cost-share programs and grant opportunities to enter cooperative agreements with riverfront property owners.
- Evaluate causes of streambank destabilization and determine the best possible actions for restoration by identifying and monitoring bank erosion and exploring opportunities to enter cooperative agreements with riverfront property owners.

Recreation Resources

- Provide a high quality recreation opportunity while protecting the river's outstanding resources and recognizing the needs of river outfitters and individual users. Place the highest priority on recreation opportunities requiring a quiet and high-quality natural ecosystem. Evaluate the authorized OSRC float areas and maintain ongoing research programs to track visitor patterns.
- Provide all visitors with the proper orientation to types of activities available, river safety information and expected behavior. Educate visitors on the outstanding natural, cultural, and historical values of the Illinois River basin.
- Encourage river users to respect the resources available to them through education and proper facility placement, thus reducing trespass on private lands. Develop a management plan for public access areas for day use and camping.

Water Quality

- Minimize alteration of stream habitat and sedimentation due to destabilization of stream beds; work with Arkansas to designate the Illinois River and its tributaries in that state as "outstanding resource waters."
- Reduce nutrient and pesticide loading into the basin from commercial nursery tailwater and pollutant loading into the river from urban runoff.
- Reduce nutrient pollution due to animal waste by requiring contracted producers to complete and implement approved conservation plans.
- Protect riparian areas from the impacts of livestock by educating livestock producers on negative consequences and promoting cost-incentive programs.
- Implement training and utilize volunteer labor to collect water quality data. Help with public education.

Implementation of measures to address these goals is a daunting effort and the OSRC plan recommends prioritizing issues and strategies to address each issue in order that limited funds available can be used in a the most cost-effective manner. Such a proposal seems to indicate that water quality issues be given highest priority, as other issues depend on the continued quality of the water. This suggests that measures must be put in place that will stop pollution at it source, that is to retain pollutants on the land surface,

riparian area, and stream bank rather than allowing them to enter the stream.

Whatever methods are implemented towards reaching goals defined by the public and concerned agencies, the OSRC plan stresses the importance of continued monitoring in the basin, both to determine the success and/or failure of implementation measures and to plan for the future of the resource. The plan recommends continued monitoring of land use, visual quality, cultural resources, vegetation and wildlife, recreational use - both of concerning the river user and physical impacts caused by river users, water quality, habitat quality, and fish species and abundance.

The OSRC plan also discussed issues which were perceived as having secondary importance compared to the main issues of corridor maintenance, recreational value, and water quality. Although these issues were considered secondary, they are nonetheless important and should be addressed when possible. These issues include:

- Visual Resources- the Oklahoma and National Wild and Scenic Rivers Act specifically identified scenery as an important resource which should be preserved and enhanced. Areas within the river corridor and viewshed should be managed to preserve visual qualities.
- River Setbacks- Agencies should work with landowners on a volunteer basis to develop adequate setbacks from the rivers edge. A 60-100 foot riparian buffer is generally considered minimum to screen most activities beyond that distance.
- Cultural Resources- State Agencies should work closely with Native American groups in identifying and protecting cultural resources located within the river corridor. Agencies should prepare and maintain an inventory of historical and archeological resources within the river corridor.
- Fire- Direct and indirect efforts towards fire suppression have led to a buildup of fuel load which increases the opportunities for wildfires to develop. Wildfire suppression actions should be coordinated with adjoining landowners, volunteer fire departments, and appropriate state agencies.
- Exotic Vegetation Management-To reduce the likelihood of exotic plant take-overs, agencies should work with landowners to clip and burn non-native plants. Any non-native plants introduced should be annuals, primarily grasses or other species that would provide temporary cover, but not persist over time.
- Wildlife- Maintenance of habitat diversity and wildlife viewing opportunities should be coordinated between state and federal agencies.
- Joint Oklahoma and Arkansas Management of the River- Management should consider needs of both states and should incorporate efforts by both states on the behalf of the watershed.
- Maintaining Water Quality- Agencies should take all action necessary to prevent further degradation of water quality, including regular water quality monitoring and stringent sewage and erosion controls. Efforts should also be maintained to promote adequate healthy aquatic habitat.

- Chemical Spills- Procedures should be formulated for handling hazardous material spills that might threaten resources within or near the river corridor.
- Floodplain Issues-The potential loss of life and monetary damage arising from a major flood has risen due to residential and commercial development within the floodplain. Floodplain zoning may be the best way to accommodate local development in accordance with the National Flood Insurance Act of 1968.
- Commercial Floatation Device Operators- The number of commercial operators on the river has grown from 5 in 1970 to 16 in 1993. To reduce the impact of river users, the OSRC recommends limiting the distribution of canoes aerially and temporally to reduce the impacts of recreation on any one area of the river.
- High Water- Floating during high water can be extremely dangerous. A management goal is to provide all users with sufficient information so they can make intelligent decisions about whether to float. No permit system to restrict use during high flows should be imposed at this time.
- Fishing- issues concerning conflict between anglers and nonanglers, angler trespassing, and limited resources should be addressed through appropriate education.
- Swimming and bathing- swimming should be permitted as long as state and local health standards are maintained. The use of soap, shampoo, detergents, and other cleaning agents while in the river is prohibited.
- Sightseeing- A scenic byway management plan to address the needs of sightseers, including pull-offs and parking area development should be developed.
- Motorized boating- Motorized boating which disturbs wildlife and solitude and may also cause safety problems should be discouraged along the river corridor.
- Camping and Day Use- Based on observations of crowding, resource degradation, and increasing maintenance requirements, there is a need for more intensive management of primitive camping areas operated by the OSRC. A system to enforce visitor carrying capacity and allocate use among user groups should be implemented when monitoring indicates environmental or social capabilities are being reached or that increased supervision is needed to properly utilize the river's physical capacity.
- User fees- Floaters who rent from commercial operators pay $1.00 per boat for a float permit. No fee is charged for camping at public access areas. It is suggested that the fee system continue.
- Human Waste and Litter Problems- Human waste and litter present obvious detriments to the corridors natural resources, aesthetics, and recreational opportunities. Vault toilets are being offered at reasonable intervals, but use is dependant upon conscientiousness of river users. A "pack it in - pack it out" philosophy should be encouraged among river users through signs and brochures. All canoes should be equipped with a litter bag. A current ban on use of glass and Styrofoam containers should be continued.
- Information and Education- the OSRC should emphasize the development of a coordinated public education program that utilizes signs, brochures, maps, and

other material to gain pubic understanding of rules, regulations, and activities which affect water quality.

- Interpretation- OSRC rangers performing routine work should be encouraged to maintain a high level of rapport with river users and in addition to law enforcement and resource monitoring responsibilities should assist in providing interpretive services to river corridor users.
- Access- Additional planning and development is needed to improve access and reduce potential impacts.
- Signing- Signs should be in the same format and located a predictable places. More of the various agency directed projects should be labeled with information identifying the agency responsible and education concerning the project, when appropriate.
- Land Acquisition and Easement Policy- the OSRC should seek acquisition of scenic or conservation easements on high priority tracts of land within the corridor based on the potential for future development, the potential for use by the public, the sensitivity of the land, and the opportunity for acquisition.

COST OF REMEDIATION

The estimated cost of remediation programs are summarized in this section. The accuracy of these estimates vary; however, for the purpose of discussion they are useful for comparing the costs of different approaches to controlling pollution within the Illinois River Basin. These values primarily represent the cost of implementation activities and do not take into account the positive or negative economic impacts of some potential solutions. In addition, this list does not include all of the potential solutions although it does address most of the major issues.

I.	Upgrading WWTFs	$5,300,000
II.	Recreation	$400,000
III.	Lake Frances	$500,000
IV.	Animal Production	$10,000,000
V.	On-Site Waste Disposal	$40,500,000
VI.	Gravel Mining	?
V.	Nurseries	?

The overall cost of remediating the problems in the Oklahoma portion of the Illinois River Watershed will be quite high. The OCC has allocated a significant portion of their FY1999

funds to address nonpoint source pollution problems in the Illinois River. Over 2 million dollars will be used to provide cost-share assistance to landowners to install BMPs in the watershed. The money will also be used to monitor water quality and other factors to verify the effects of these installations. The program will be administered by a Watershed Advisory Group (WAG), made up of local citizens and decision makers. The WAG will determine what types of BMPs will receive cost-share assistance and where the program should be concentrated. The plan will also be forwarded to members of the Nonpoint Source Working Group (a group, led by the OCC, made up of federal and state government agencies, nonprofit organizations, tribes, and agricultural producer organizations for the purpose of providing review of and direction to the State's Nonpoint Source Program) for review and comment.

Given the economic resources available, it may be impossible to fix all of the problems in the watershed. Thus, remediation efforts should focus in the most cost-effective manner. Thus, most of the future efforts should probably focus on reducing the impacts to the watershed from animal production operations. Much is already being done to reduce nutrient impacts to the watershed and substantial funds have been allocated towards reducing point and nonpoint source loading. Additional funds necessary to protect the water resources are difficult to estimate before the success of the currently planned activities can be determined.

It is impossible to know whether the planned activities referenced in this document will solve or curb the water quality problems in the river basin. Thus, the most appropriate course of action may be to continue to follow the phase program of implementation that is currently in place. Now that most of the point sources have been upgraded and a significant nonpoint source program is planned to focus on the main sources of water quality problems, it may be best to wait to determine the impact of these programs. Based on the success of these programs, it may or may not be necessary to revisit the basin with a second-phased approach to focus on areas such as Lake Frances, pit toilet facilities, use reduction provisions, or intensive streambank restoration measures.

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